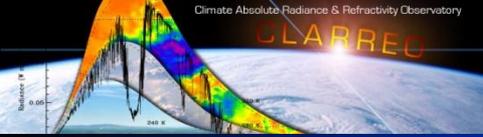


# Climate Absolute Radiance and Refractivity Observatory (CLARREO)

## Extended Pre-Phase A Engineering Focus Areas

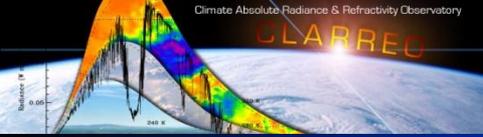
Briefing to CLARREO Science Team  
October 2011





# Overview

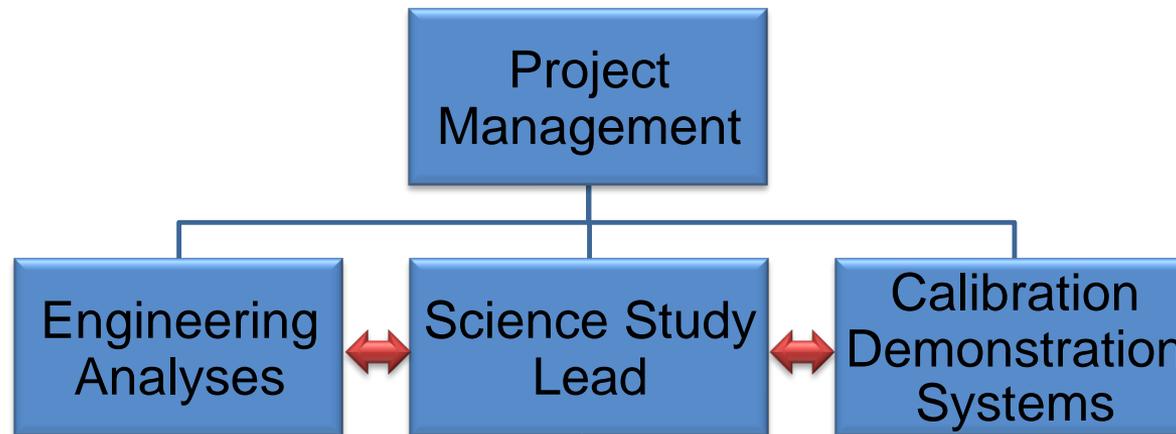
- **CLARREO Organization & Engineering Scope**
- **Identifying Alternative Opportunities**
- **Spacecraft Accommodations & Opportunities with Existing Projects**
  - Iridium Accommodation Study
  - FastSat Accommodation Study
- **Assessment Input to Science Studies**
- **Continued Support of Science Studies**

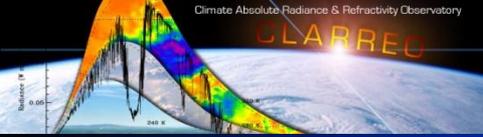


# Extended Pre-Phase A Organization

- **Primary Objectives:**

- Identifies alternative means of achieving some of the CLARREO science objectives in a cost effective manner
- Identifies and pursues enabling work that will provide the agility, reduced risk and foundational science needed to capitalize on opportunities for implementing the alternative approaches



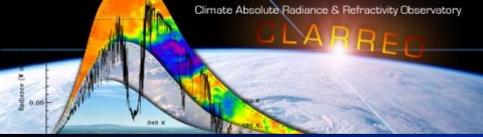


# Engineering Scope

- **Develop and Evaluate Alternative Mission Concepts**
  - Engineering analysis of Missions of Opportunity concepts
  - Identify potential host spacecraft and mature vendor relationships
  - Access to Space Opportunities (Commercial, DoD, International)
  - Perform cost estimates for alternative instrument and mission concepts
- **Preliminary Instrument Accommodations Analyses**
  - Assessment of existing instrument synergy within established opportunities
  - Define compatibility targets for “out of scope” metrics
  - Update engineering portion of Science Value Matrix
- **Support Science Studies**
  - Orbital Sampling for Spectral Fingerprinting
  - Orbital Sampling for Reference Intercalibration

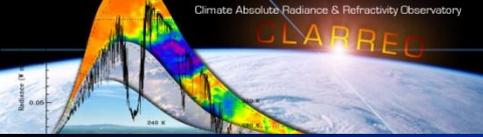
***Alternative options will be considered primarily by the ratio, Science Value / Cost.***





# Alternative NASA Opportunities

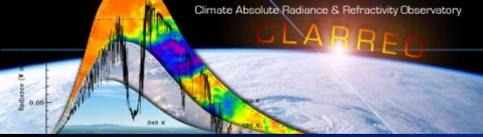
- **Earth System Science Pathfinder (ESSP) Program**
  - Earth Venture-2 solicitation (FIREX, Zeus proposals submitted: Sept 2011)
  - Earth Venture-Instruments (Draft AO released Sept. 29)
  - Common Instrument Interface (CII)
    - Continued interface with CII to understand guidelines for data, electrical power, mechanical, thermal, environmental, software, contamination.
    - Block-buy Affordability Study Kickoff set for next week
- **Stand Alone Missions of Opportunity (SALMON-2)**
  - Solicits proposals for Missions of Opportunity (MO) through NASA Mission Directorates (5 year cycle)
- **Earth Systematic Missions (ESM) Program**
  - Potential MOO with future Decadal Survey missions.



# Hosting on Existing Platforms

- **International Space Station**
  - Offers large payload mass and volume allocations
  - Logistics, access to space, and attitude variations need to be considered
- **Iridium NEXT**
  - Has the advantage of numerous launch opportunities, but offers only small payload mass and volume allocations
- **Small Satellites: FASTSAT (MSFC)**
  - Initial studies of the MSFC FASTSAT satellite bus indicate that the CLARREO infrared and reflected solar instruments are too large for this platform
  - Future studies will investigate other existing small satellite opportunities
- **ESPA (DoD)**
  - Offers a well known interface for small spacecraft but poses some programmatic issues that need to be addressed
- **International & Inter-Agency Systems**
  - UK, EUMETSAT Polar System, Korean Meteorological Administration, NOAA

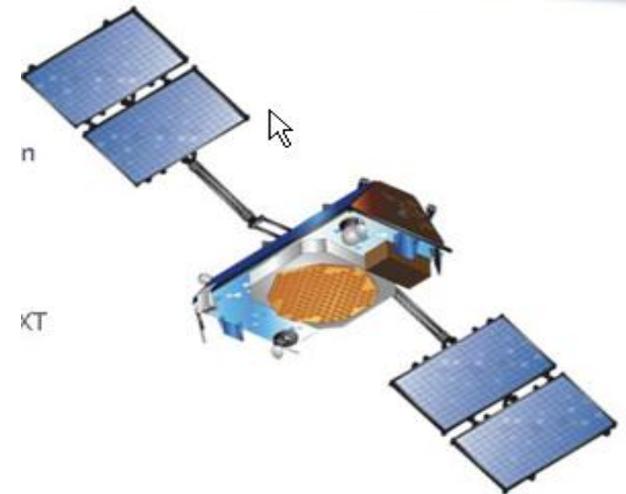




# Iridium & FASTSAT

## • Iridium

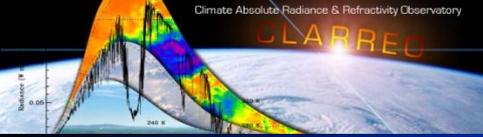
- Anticipated to begin launching in 2015
- 66 cross-linked satellites, 6 planes of 780 km, 86.4 deg. inclination
- 50 kg, 30 x 40 x 70 cm volume, 50 WOAP (200 W Peak), 1 Mbps
- Near-nadir observation



## • FASTSAT (NASA MSFC)

- NASA/DoD microsat design supports standards of the ESPA ring
- 1 of 3 secondary microsat payloads launched Fall 2010 on Minotaur IV

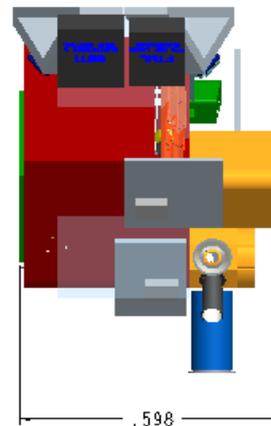
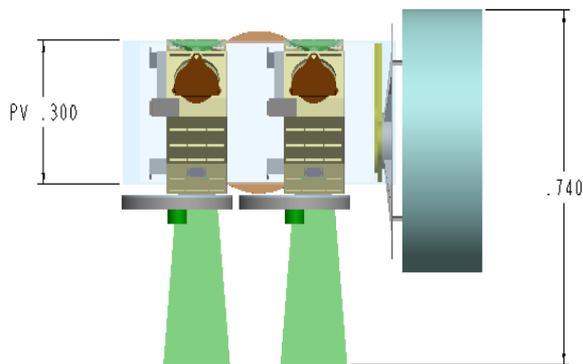




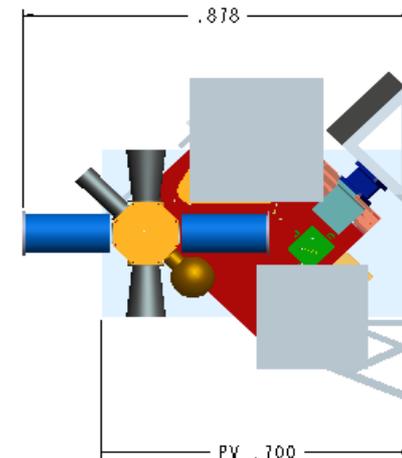
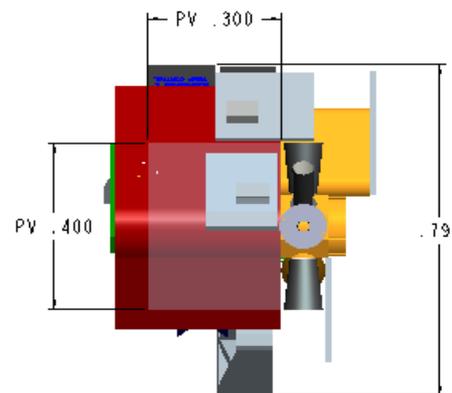
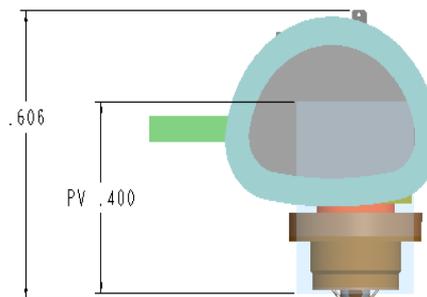
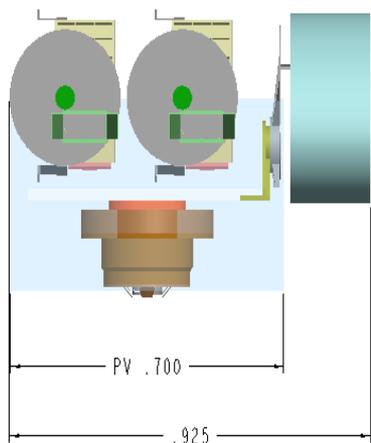
# CLARREO Baseline IR & RS Instrument Configuration

## Design Analysis Cycle 6, January 2011

### Reflected Solar

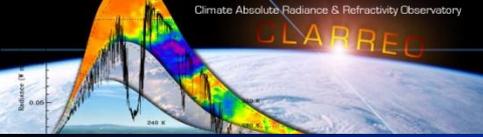


### Infrared



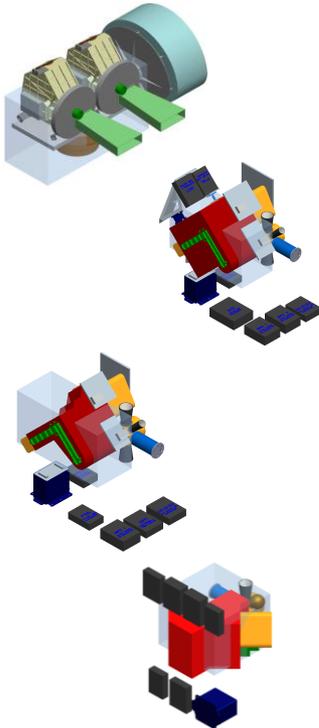
**Instrument vs. Payload Volume Size (dimensions in m, electrical enclosures removed)**

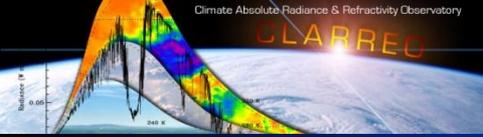




# Iridium & FASTSAT Accommodation Studies

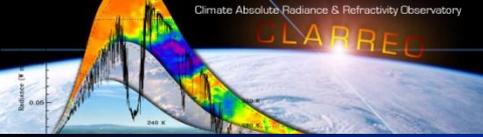
	IRIDIUM	FASTSAT HSV01	FASTSAT A110	FASTSAT A210
Reflected Solar (DAC-6)	Mass: No Volume: No	Mass: No Volume: No	Mass: No Volume: No	Mass: No Volume: No
Infrared Instrument (DAC-6)	Mass: No Volume: No	Mass: No Volume: No	Mass: No Volume: No	Mass: No Volume: No
Far IR	Mass: Yes Volume: No	Mass: No Volume: No	Mass: Yes Volume: No	Mass: Yes Volume: No
2-port IR	Mass: Yes Volume: No	Mass: No Volume: No	Mass: Yes Volume: No	Mass: Yes Volume: No





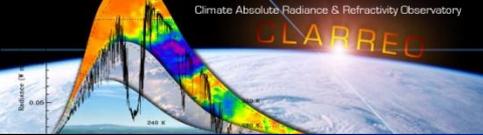
# Access to Space Opportunities

- **Launch Affordability is dependent on our role as a:**
  - Hosted Payload: a payload manifested on a spacecraft bus flying on a primary space mission. (ESPA)
  - Secondary Payload: a small spacecraft flying on a primary science mission, paying only the additive costs of integration, and willing to be deployed into the prime payload's insertion orbit after its separation. (CALIPSO, CLOUDSAT)
  - Rideshare: a secondary spacecraft launched into space on a large launch vehicle and deployed after the primary spacecraft. (ESPA)
  - Hosted Payload Opportunity: a spacecraft bus flying on a primary space mission with surplus resources to accommodate a hosted payload. (IRIDIUM NEXT)
- **Orbit selection possibly not within our control**
  - Engineering studies will provide input to Science Studies to characterize impact to science value
  - Environmental impacts (thermal, power) to CLARREG instruments will be assessed.

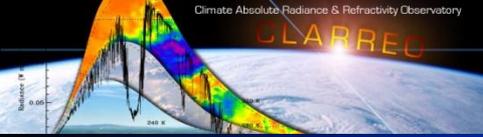


# Supporting Science Studies

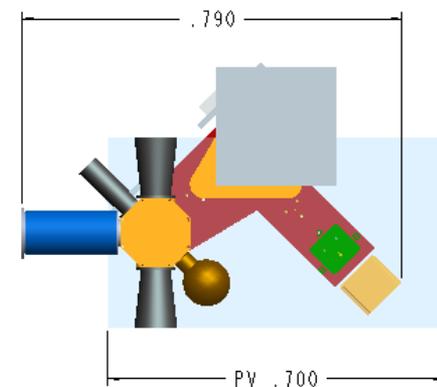
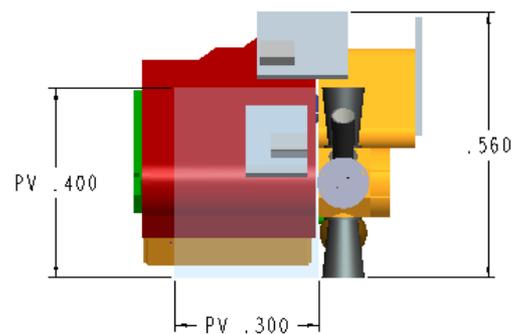
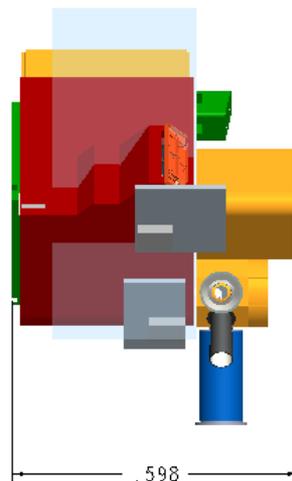
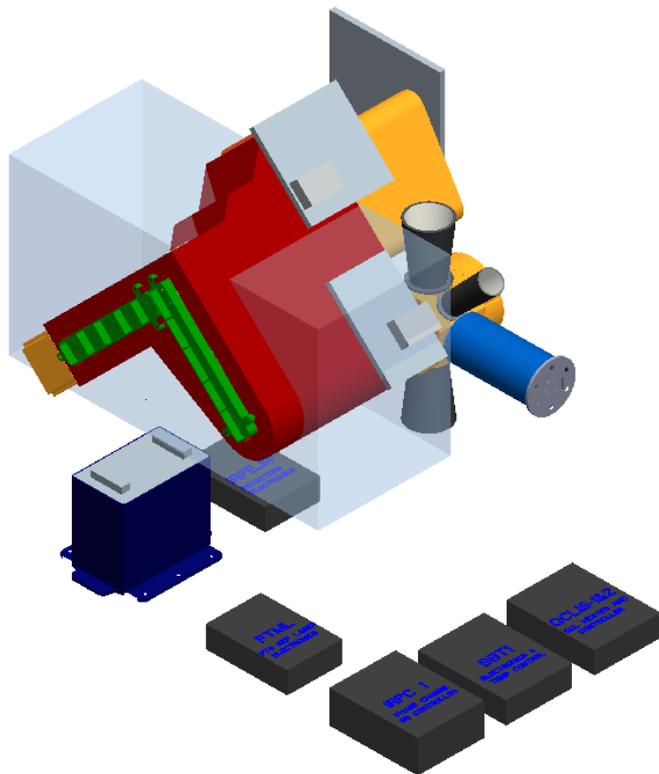
- **Provide targets for physical metrics to achieve compatibility**
  - Accommodation studies will characterize available mass, power consumption, volume, and data envelopes
  - These targets can be used for modified instrument designs
- **Provide cost estimation for instrument and mission concepts**
  - NASA Instrument Cost modeling and Mission & Operations Cost capability
  - Cost data will become input for updating Science Value assessment.
- **High Precession Orbit Propagation ephemeris for orbit sampling studies (Doelling)**
- **Provide simulation results of Reference Intercalibration with LEO and GEO assets (LEO & GEO; IR & RS) (Lukashin, etc.)**



# BACKUP

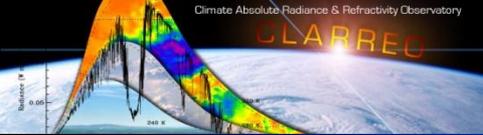


# CLARREO Far-IR Instrument Configuration

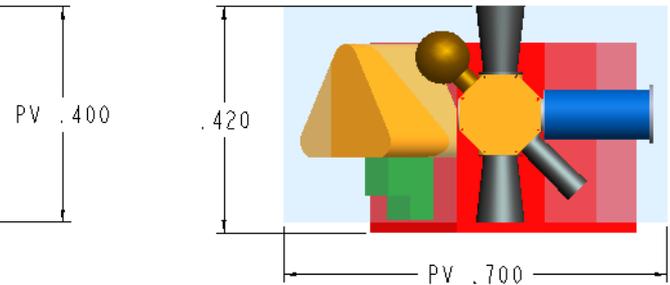
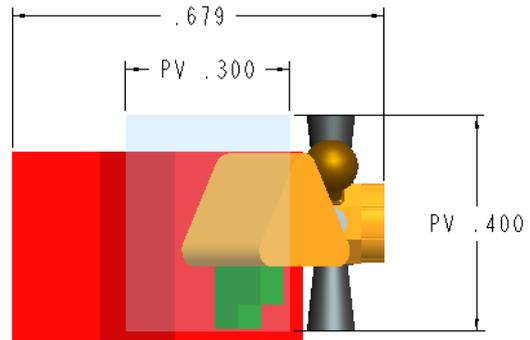
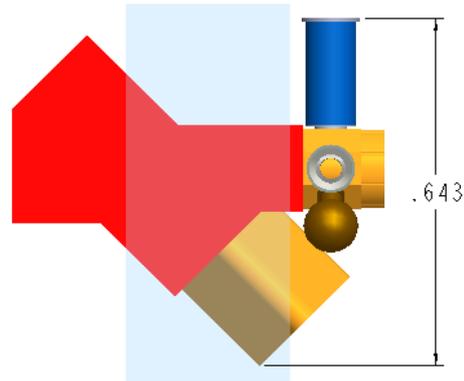
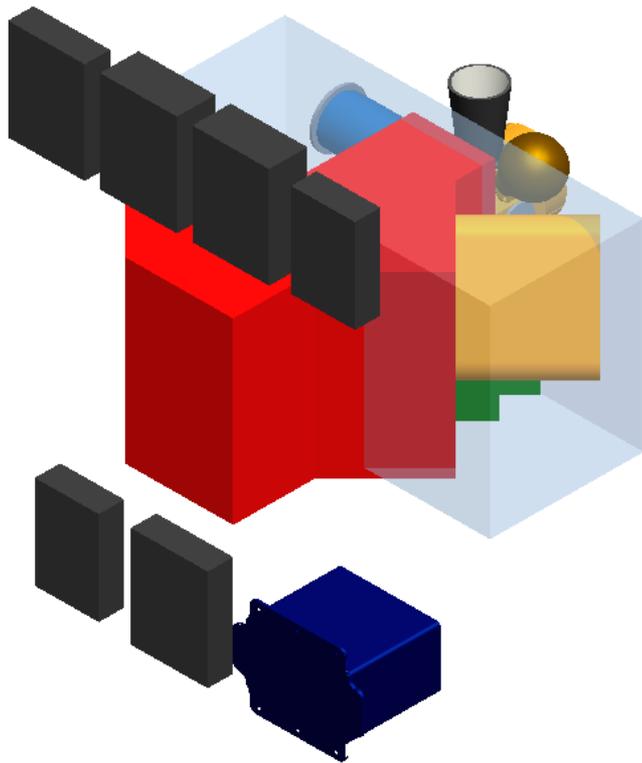


**Instrument vs. Payload Volume Size (dimensions in m, electrical enclosures removed)**



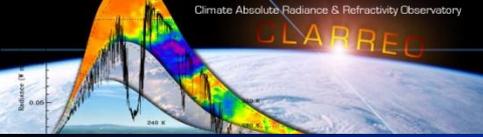


# CLARREO Two Port Instrument Configuration



Instrument vs. Payload Volume Size (dimensions in m, electrical enclosures removed)

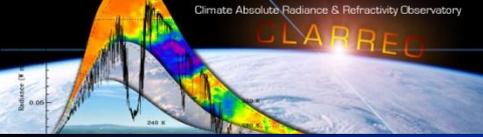




# RS Instrument Configuration vs. Iridium Payload Mass and Volume Constraints

	<b>Payload Mass – 50 kg</b> <b>Payload Volume – 84000 cm<sup>3</sup>, 70 x 30 x 40 (cm)</b>	
	Instrument Mass (kg), Meets Constraint (Yes, No)	~ Required Instrument Payload Volume* (cm <sup>3</sup> ), Measurements L x W x H (cm) Meets Constraint (Yes, No)
<b>CLARREO</b> <b>Baseline DAC-6</b>	85, No	463125, 75 x 95 x 65, No

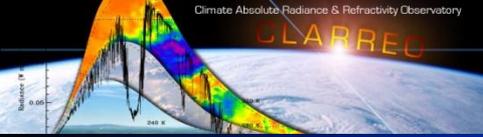
\* Volume accounts for instrument only. Electrical enclosures not included.



# RS Instrument Configuration vs. HSV01 Payload Mass and Volume Constraints

	<b>Payload Mass – 21 kg</b> <b>Payload Volume – 100000 cm<sup>3</sup>, 50 x 50 x 40 (cm)</b>	
	Instrument Mass (kg), Meets Constraint (Yes, No)	~ Required Instrument Payload Volume* (cm <sup>3</sup> ), Measurements L x W x H (cm) Meets Constraint (Yes, No)
CLARREO Baseline DAC-6	85, No	463125, 75 x 95 x 65, No

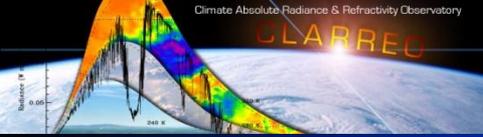
\* Volume accounts for instrument only. Electrical enclosures not included.



# RS Instrument Configuration vs. A110 Payload Mass and Volume Constraints

	<b>Payload Mass – 70 kg</b> <b>Payload Volume – 125000 cm<sup>3</sup>, 50 x 50 x 50 (cm)</b>	
	Instrument Mass (kg), Meets Constraint (Yes, No)	~ Required Instrument Payload Volume* (cm <sup>3</sup> ), Measurements L x W x H (cm) Meets Constraint (Yes, No)
CLARREO Baseline DAC-6	85, No	463125, 75 x 95 x 65, No

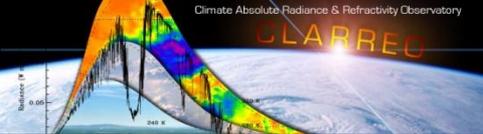
\* Volume accounts for instrument only. Electrical enclosures not included.



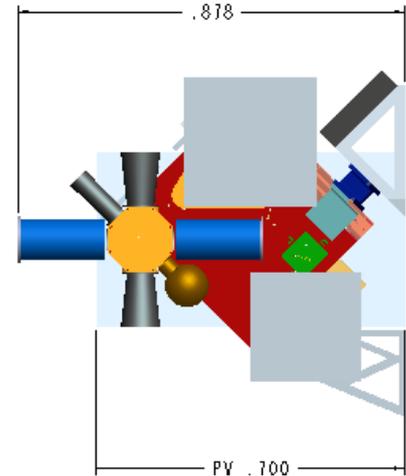
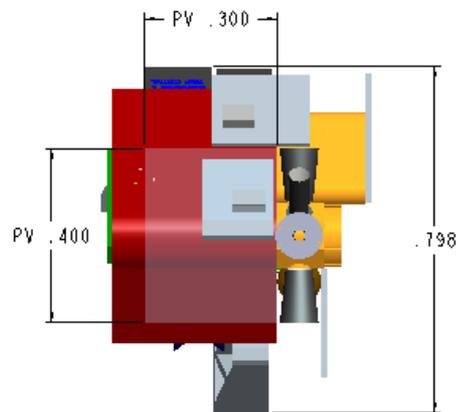
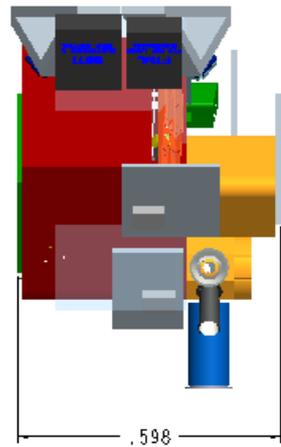
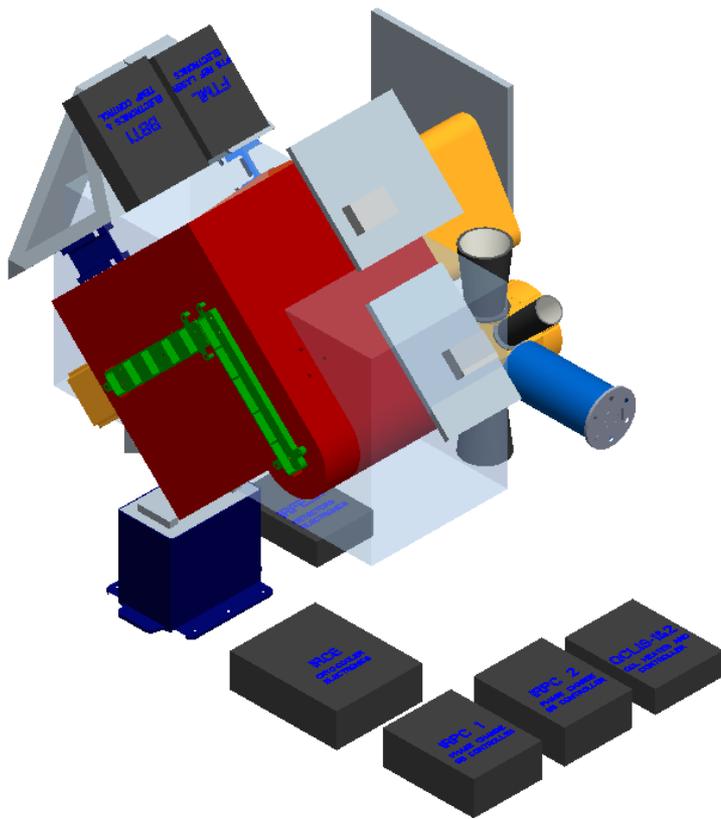
# RS Instrument Configuration vs. A210 Payload Mass and Volume Constraints

	<b>Payload Mass – 65 kg</b> <b>Payload Volume – 125000 cm<sup>3</sup>, 50 x 50 x 50 (cm)</b>	
	Instrument Mass (kg), Meets Constraint (Yes, No)	~ Required Instrument Payload Volume* (cm <sup>3</sup> ), Measurements L x W x H (cm) Meets Constraint (Yes, No)
<b>CLARREO</b> <b>Baseline DAC-6</b>	85, No	463125, 75 x 95 x 65, No

\* Volume accounts for instrument only. Electrical enclosures not included.

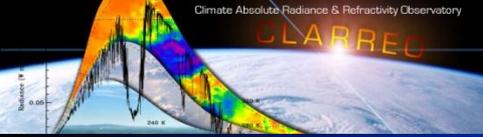


# CLARREO Baseline IR Instrument – DAC6 Configuration



**Instrument vs. Payload Volume Size (dimensions in m, electrical enclosures removed)**

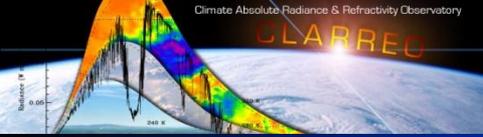




# IR Instrument Configuration vs. Iridium Payload Mass and Volume Constraints

	<b>Payload Mass – 50 kg</b> <b>Payload Volume – 84000 cm<sup>3</sup>, 70 x 30 x 40 (cm)</b>	
	Instrument Mass (kg), Meets Constraint (Yes, No)	~ Required Instrument Payload Volume* (cm <sup>3</sup> ), Measurements L x W x H (cm) Meets Constraint (Yes, No)
CLARREO Baseline DAC-6	74, No	432000, 90 x 60 x 80, No
Far-IR	45, Yes	288000, 80 x 60 x 60, No
Two Port	48, Yes	204750, 65 x 70 x 45, No

\* Volume accounts for instrument only. Electrical enclosures not included.

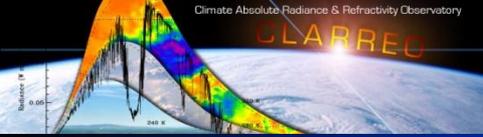


# IR Instrument Configuration vs. HSV01 Payload Mass and Volume Constraints

	<b>Payload Mass – 21 kg</b> <b>Payload Volume – 100000 cm<sup>3</sup>, 50 x 50 x 40 (cm)</b>	
	Instrument Mass (kg), Meets Constraint (Yes, No)	~ Required Instrument Payload Volume* (cm <sup>3</sup> ), Measurements L x W x H (cm) Meets Constraint (Yes, No)
CLARREO Baseline DAC-6	74, No	432000, 90 x 60 x 80, No
Far-IR	45, No	288000, 80 x 60 x 60, No
Two Port	48, No	204750, 65 x 70 x 45, No

\* Volume accounts for instrument only. Electrical enclosures not included.

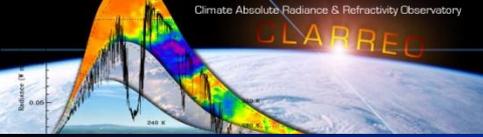




# IR Instrument Configuration vs. A110 Payload Mass and Volume Constraints

	<b>Payload Mass – 70 kg</b> <b>Payload Volume – 125000 cm<sup>3</sup>, 50 x 50 x 50 (cm)</b>	
	Instrument Mass (kg), Meets Constraint (Yes, No)	~ Required Instrument Payload Volume* (cm <sup>3</sup> ), Measurements L x W x H (cm) Meets Constraint (Yes, No)
CLARREO Baseline DAC-6	74, No	432000, 90 x 60 x 80, No
Far-IR	45, Yes	288000, 80 x 60 x 60, No
Two Port	48, Yes	204750, 65 x 70 x 45, No

\* Volume accounts for instrument only. Electrical enclosures not included.



# IR Instrument Configuration vs. A210 Payload Mass and Volume Constraints

	<b>Payload Mass – 65 kg</b> <b>Payload Volume – 125000 cm<sup>3</sup>, 50 x 50 x 50 (cm)</b>	
	Instrument Mass (kg), Meets Constraint (Yes, No)	~ Required Instrument Payload Volume* (cm <sup>3</sup> ), Measurements L x W x H (cm) Meets Constraint (Yes, No)
CLARREO Baseline DAC-6	74, No	432000, 90 x 60 x 80, No
Far-IR	45, Yes	288000, 80 x 60 x 60, No
Two Port	48, Yes	204750, 65 x 70 x 45, No

\* Volume accounts for instrument only. Electrical enclosures not included.